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PROSPECTS FOR WORLD FISHERIES TO 2000

by

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PREPARATION OF THIS DOCUMENT

This document has been prepared as part of FAO's continuing review of long run trends and prospects in the food and agricultural situation. It forms part of a wider study examining such aspects - AGRICULTURE: TOWARD 2000 - whose provisional results were considered by the FAO member countries at the Nineteenth Session of the Conference in November 1979 and further reviewed in a revised and abbreviated version at the Twentieth Session held in November 1981.

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ABSTRACT

In the context of a growing shortage of supply and the establishment of exclusive economic zones, the paper analyzes the implications for fisheries of the growth of world population and income and related growth in demand for food and other products. Since demand for food fish could double in the next twenty years, while trends in production are likely to remain less dynamic, the long-run perspective is for an increase in the real price of fish. Sources of possible increases in production through capture and culture are reviewed and the need for rational management of resources and better utilization of catches is stressed. Policy issues which will require attention both at national and international level are also discussed.

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PROSPECTS FOR WORLD FISHERIES TO 2000

A. PAST TRENDS

1. The past decade has seen a profound change in the World fishery situation. In fact, 1969 was the first year since good statistics became available that the World catch fell and although it increased sharply in 1970 growth since has been both erratic and slow. Although most projections made in the nineteen sixties were influenced by the diminishing number of stocks offering the possibility of sustained increases in catch, it was not foreseen that the rate of growth of World production would decline so soon and so sharply. Throughout the seventies, in fact, the rate of growth of landings has been lower than that of World population with a consequent decline in the contribution of fish to human nutrition.

2. The growth and stagnation of the World fish catch during the past two decades has been much influenced by the growth and decline of fisheries exploited largely for reduction of their landings to meal and oil. These fisheries accounted for 64 percent of the rise in production in the period 1960/70. Likewise, since 1970, the fall of over four million tons in landings used for reduction has largely accounted for the slow growth in the World catch. Predominant among these fisheries was that for the anchoveta of the Peru current from which Chile and Peru combined increased their landings by nine million tons between 1960 and 1970 but catches from which have since declined from a peak of 13 million tons in the latter year to about one million tons today. The Northeast Atlantic herring fisheries have suffered a largely similar fate - the Atlanto-Scandian herring in particular reaching a peak of 1.7 million tons in 1968 but now not yielding catches of commercial significance. In addition to the much reduced anchoveta catches, world fish meal production is today largely sustained by capelin - a small marine salmonoid fish - and by a variety of other species including particularly mackerel and sardine.

Table 1. World Production of Living Aquatic Organisms

	Production			Increase		Rate of Increase	
	1960	1970	1978	1970/60	1978/70	1970/60	1978/70
	...million tons...					% per annum	
TOTAL	40.2	67.2	73.6	27.0	6.4	5.3	1.2
Developing Countries	17.0	33.7	35.4	16.7	1.7	7.1	0.6
Developed Countries	23.2	33.5	38.2	10.3	4.7	3.7	1.7
FOOD	31.6	41.3	52.0	9.7	10.7	2.7	2.9
Developing Countries	13.1	18.1	27.4	5.0	9.3	3.3	5.3
Developed Countries	18.5	23.2	24.6	4.7	1.4	2.3	0.8
NON FOOD	8.6	25.9	21.6	17.3	-4.3	11.6	-2.2
Developing Countries	3.9	14.4	8.0	10.5	-6.4	14.0	-7.1
Developed Countries	4.7	11.5	13.6	6.8	2.1	9.4	2.1

3. In contrast to landings for reduction to meal and oil, production of fish for direct human consumption grew steadily throughout the sixties and seventies, although since 1970 the rate of growth has declined. The increase in the landings of food fish in the developed world has come largely from a handful of countries, i.e. Japan, the USSR and the centrally planned countries of Eastern Europe and Spain.

4. The decline in the rate of growth of food fish production in developing countries has only become apparent in the past two or three years and is even now only seriously affecting a limited number of countries influenced by special factors, e.g. Ghana and Thailand adversely affected by limit extensions. Until recently the increase in the production of fish for direct human consumption has been generally widespread in the developing countries even if at varying rates of growth, i.e. slow in some middle eastern countries and fairly rapid in Latin America and Asia. Total food fish production in developing countries growing at a rate of some 4.0 percent per annum has considerably more than doubled in the period 1960/80 and with the concentration on high value export species the real growth in monetary output will have been higher although this does mean that consumption in these countries has grown less rapidly than production.

5. Trends in trade in fishery products reflect closely changes in production. Thus the volume of exports of fish meal declined sharply in the early seventies from a peak of 3.5 million tons in 1968 and continues to fluctuate at a level some 1.5 million tons below this. Fish oil has shared in this decline but trade in products for human consumption has, in most cases, increased. Shellfish exports in particular have increased steadily to the advantage of the balance of payments of many developing countries in Asia and Latin America. Trade in frozen fish has also grown with exports from developing countries playing an increasingly important role.

B. POSSIBILITIES OF CATCH INCREASES

6. The growth in food fish production in the developing countries is one of the few trends in world fisheries continuing throughout the sixties and seventies but it has not been sufficient to prevent the rate of growth of total world catch from declining drastically - from around 5 percent in the sixties to one percent in the seventies. The basic cause of this decline is the diminishing number of stocks of conventional fish (i.e. those harvestable by existing types of gear and readily marketable in existing product forms) which offer the possibility of sustained increases in catch.

7. The present level of exploitation compared with the commercially realizable potential of broad groups of conventional types of marine fish, crustaceans and cephalopods is reviewed in Table 2. This indicates that marine catches can probably be increased by a further 20 to 30 million tons over present levels 1/. The data, however, need to be interpreted with caution because only a part of this theoretical increase in catch is realizable through increased fishing and a substantial part - possibly as much as 50 percent - will be achieved only by better management.

1/ The sum of the potential of all stocks considered in isolation would give a potential up to perhaps 20 percent greater than that shown in Table 2. It is, however, practically impossible to exploit all stocks on a sustained basis to 100 percent of their potential for reasons concerned with species interaction, unintended catches of one species while fishing for another, etc., and the full potential of conventional stocks of the world's oceans given in the table has been discounted by 20 percent to allow for the effect of these factors

Table 2: Catch of Marine Fish, Crustaceans and Cephalopods (1979) and Estimated Potential[1/] by Marine Areas and Species[2/]

- Million Tons -

	Oceanic Pelagic		Demersal		Shoaling Pelagic		Cephalopods		Crustaceans		Total	
	1979 Catch	Potential	1979 Catch	Potential	1979 Catch	Potential	1979 Catch	Potential	1979 Catch	Potential	1979 Catch	Potential
ATLANTIC OCEAN												
Northwest	0.01		1.29	2.24	0.57	1.60	0.18	?	0.15	0.16	2.20	
Northeast	0.05		5.72	4.80	5.24	6.40	0.02	0.80	0.16	0.17	11.19	
Western Central	0.06		0.27	2.00-2.80	1.00	1.60-2.80	0.01	0.50	0.24	0.32	1.58	
Eastern Central	0.25	0.88	0.63	0.80	1.77	2.50	0.12	0.20	0.04	0.03	2.81	>31.49->33.49
South Western	0.02		0.92	2.00	0.33	1.20	0.12	>0.80	0.07	0.11	1.46	
South Eastern	0.05		0.66	>0.80	1.78	2.00	0.01	0.04	0.01	0.04	2.51	
Antarctic	-		0.13	?	0.00	?	0.00	?	-	-	0.13	
TOTAL ATLANTIC	0.44	0.88	9.61	>12.64->13.44	10.69	14.80-16.00	0.46	>2.34	0.68	0.83	21.88	>31.49->33.49
PACIFIC OCEAN												
Northwest	0.70		8.33	9.00	6.26	6.00	0.80	0.81	0.75	0.40	16.84	
Northeast	0.31		1.37	1.92	0.07	0.96	0.00	0.08	0.19	0.24	1.94	
Western Central	0.76		1.50	3.20-4.00	2.52	3.20-4.00	0.14	0.16	0.48	0.48	5.40	
Eastern Central	0.41	2.20	0.20	0.80	1.26	1.60-2.00	0.03	0.40-0.80	0.09	0.40	1.98	37.81-46.61
South Western	0.05		0.18	0.80	0.04	0.80	0.06	0.12	0.01	0.01	0.33	
South Eastern	0.03		0.32	0.56	6.36	3.20-9.60	0.00	0.40	0.04	0.07	6.75	
Antarctic	-		-	-	-	-	-	-	0.00	?	-	
TOTAL PACIFIC	2.26	2.20	11.89	16.28-17.08	16.51	15.76-23.36	1.03	1.97-2.37	1.56	1.60	33.24	37.81-46.61
INDIAN OCEAN												
Western	0.18		0.74	1.20	1.02	2.12	0.02	0.24	0.22	0.25	2.19	
Eastern	0.10	0.56	0.52	1.00	0.60	0.82	0.01	0.16	0.08	0.11	1.31	6.46
Antarctic	-		0.00	?	0.00	?	-	-	0.00	?	-	
TOTAL INDIAN	0.28	0.56	1.26	2.20	1.62	2.94	0.03	0.40	0.30	0.36	3.50	6.46
MEDITERRANEAN	0.02	0.04	0.33	0.40	0.76	0.80	0.04	0.06	0.03	0.04	1.18	1.34
WORLD TOTAL	3.00	3.68	23.09	>31.52->33.12	29.58	34.30-43.10	1.56	>4.77->5.17	2.57	2.83	59.80	>77.1->87.9

1/ See paragraph 7 and footnote.
2/ Excludes Molluscs other than Cephalopods and unconventional species, e.g. krill.

8. This is particularly the case with pelagic species which offer considerable possibilities of catch increases and which well illustrate the divergent forms of action required to produce them. For those stocks such as the anchovy of the Peru current and the herring of the Northeast Atlantic which, as already mentioned, have collapsed and are now yielding much lower catches, careful management in the form of strict control of fishing effort is required if catches from these stocks are to increase to anything like their former levels. For other stocks of shoaling pelagic fish such as the herring of the Patagonian shelf or the sardine of the northwest Arabian Sea, increased yields will require an increase in fishing effort.

9. Less spectacular but still significant increases in catch can be expected from better management of demersal species, particularly flounders and cod. Among the species for which increases in fishing effort will yield higher catches, the best commercial prospects are for hake and similar species off the southern coasts of South America and in particular for the hake on the Patagonian shelf. These stocks, however, are already attracting considerable attention and by the end of the present decade are unlikely to have much potential remaining unexploited. Elsewhere and especially in the southern hemisphere and in tropical waters, there are unexploited resources, but as much of this potential consists of a wide variety of species and none in any great abundance, their commercial utilization will present, and in fact already presents, serious marketing problems.

10. For shellfish the possibilities of increased production are generally good and for many products future levels of output are likely to depend as much on market considerations as on resource availability. For example, cephalopods (squids, cuttlefish, octopus, etc.) are, in many areas of the world, only very lightly exploited but at the same time are regarded as conventional foods in only a handful of countries. Thus, without very considerable product development or consumer education, the full potential of this valuable resource seems unlikely to be realized even by the end of the century. Consumer acceptance is also a factor likely to govern the production of mussels - possibilities for the production of which by culture are very large indeed. Given the control of pollution and the availability of seed, good prospects exist for the cultivation of other molluscs such as oysters, clams and scallops.

11. Crustaceans generally are heavily exploited but some increases in catch can be looked for, e.g. from smaller crabs and from some shrimps including those in deeper waters and in some as yet rather undersurveyed areas, e.g. the northwest coast of Australia. In the long run, however, it is clear that the supply of shrimp is likely to become increasingly inelastic and thus the consequent rising prices will give impetus to the culture of these animals. For many species the technical problems of culture have been solved and provided fry are available and the necessary environmental conditions (temperature, salinity, etc.) exist, the main determinant of increased output from culture will be the cost of inputs (mainly feed) in relation to the price of shrimp. Even though increasing and likely to double or treble, the amount of shrimp cultured by the end of the century is likely to remain small, i.e. less than 10 percent of total production.

12. Although some growth can be expected from freshwater fisheries, the most interesting developments in this sector over the next 20 years are likely to be changes in the sources of production. Both for purposes of electricity generation and irrigation, interference with natural river basin systems seem likely to continue unabated with a consequent continuing decline in rivers and flood plains while output from reservoirs and intensive aquaculture can be expected to increase.

13. Mention has already been made of the possibilities of cultivating molluscs and crustaceans and much the same considerations apply to fish, i.e. the main technical problems of expanding production are seed provision and the supply of water of the right quality while the input/output relationship represents the main economic constraint. Fish are generally hardier animals than shrimp (and some molluscs, e.g. oysters) and food requirements for the culture of some species are less demanding, which in part explains the more rapid progress in the culture of fish compared with shrimp. Cultured fish presently represent about 6 percent of total world finfish supplies, a proportion which can confidently be expected to increase over the next two decades.

C. FUTURE TRENDS IN SUPPLY

14. The state of world fishery resources as described above has provided the framework within which the projections of fish supply detailed in Table 3 were made. The slow overall growth rate - essentially a continuation of the trend in the seventies so far - results from the fact that conventional marine finfish, which account for some three quarters of the total production of living aquatic organisms, offer relatively poor prospects for increased catches. The situation is relatively more favourable in the developing countries where lightly exploited resources are somewhat more abundant than in the developed countries where technological innovation has (with some exceptions) led to the earlier heavy exploitation of stocks in adjacent waters.

15. Even within the developing countries, however, given a projected rate of population increase of over 2 percent, the rate of growth of production will on average be inadequate to maintain per caput levels of supply - notwithstanding the possibilities of diverting to direct human consumption some of the catches now used for reduction to meal and oil. Countries where significant declines in per caput consumption could occur include some of the least developed, e.g. Mali and Chad, which depend on heavily or moderately heavily exploited flood plain fisheries and where the expansion of aquaculture is likely to do little more than offset the effect of possible interference with the aquatic environment. In Uganda and Burundi also the lake fisheries are already fairly heavily exploited and the prospects for significant growth are not good.

16. Other developing countries with fairly low projected growth rates include those whose distant water (or at least non-local) operations will be affected by the establishment of exclusive economic zones (EEZs). The latter are the offshore areas extending to a distance of 200 miles in which the coastal state has sovereign rights for exploiting the natural resources and thus the right to exclude the fishing vessels of other nations. Adjustment to an ocean regime of EEZs arising from the Third UN Conference on the Law of the Sea is likely to be a major influence on changes in the pattern of fishing for most of the period to 2000. Within the developing countries, for example, the high growth rates for Argentina and some West African countries demonstrate the possibilities of production from abundant resources which have previously either been relatively lightly exploited or exploited by foreign vessels. Opportunities provided by extended jurisdiction explain also the relatively high rates projected for North America and for Oceania. The projected lack of growth in Europe reflects the fact that the resources in most EEZs are already heavily exploited by the coastal state and few opportunities exist for the development of new fisheries. Implementation of policies with respect to EEZs will have little impact on the total catch, although in the short to medium term it is likely to depress yields as coastal states in many areas take action to protect their newly acquired resources.

Table 3: Aquatic Organisms - Actual and Estimated Production

Region	Production					Rate of Increase				
	1963*	1975*	1980	1990	2000	1974-76 / 1961-65	1980 / 1974-76	1990 / 1980	2000 / 1990	2000 / 1974-76
	..... million tons					..... per cent per year				
WORLD	47.7	70.0	75.3	84.7	92.5	3.2	1.5	1.2	0.9	1.1
DEVELOPING COUNTRIES	22.8	31.6	37.3	45.6	51.9	2.7	3.4	2.0	1.3	2.0
Latin America	8.9	7.4	10.0	11.8	12.0	-1.6	6.2	1.7	0.2	2.0
Africa	2.1	3.8	4.1	5.1	6.0	6.1	1.5	2.2	1.8	1.8
Near East	0.5	0.8	1.0	1.3	1.5	4.3	3.9	2.8	1.9	2.7
Far East	5.3	11.2	12.6	15.6	18.1	6.4	2.4	2.2	1.5	1.9
Asian Centrally Planned	5.9	8.1	9.0	11.0	13.5	2.7	2.1	2.0	2.1	2.1
Other Developing	0.1	0.3	0.5	0.7	0.7	10.7	8.6	3.8	1.0	3.6
DEVELOPED COUNTRIES	24.9	38.4	38.0	39.1	40.6	3.7	-0.2	0.3	0.4	0.2
North America	4.0	4.1	4.9	6.4	6.9	0.1	3.7	2.7	0.9	2.1
Western Europe	8.9	11.5	11.7	12.5	12.9	2.3	0.1	0.7	0.3	0.4
EEC	4.2	5.3	5.2	5.3	5.5	2.0	-0.4	0.1	0.4	0.1
Other W. Europe	4.7	6.2	6.5	7.2	7.4	2.3	1.0	1.1	0.3	0.7
Eastern Europe and USSR	4.6	11.3	10.6	9.7	10.0	7.7	-1.3	-0.8	0.3	-0.5
Oceania	0.1	0.2	0.3	0.4	0.6	3.8	8.7	4.8	4.1	5.3
Other Developed	7.2	11.3	10.6	10.1	10.2	3.8	-1.3	-0.5	0.1	-0.4

1963* = Average 1961/65
1975* = Average 1974/76

D. FUTURE TRENDS IN DEMAND

17. Table 4(a) and 4(b) give details of the estimated growth in the demand for fish on the assumption of constant relative prices and on the basis of assumptions relating to income and population growth described in Chapter 1. The tables indicate a growth in the demand for fish of 2.0 percent (Scenario B) and 2.4 percent on the slightly more optimistic normative hypothesis (Scenario A). These rates should be contrasted with the estimated growth in supply of 1 percent. Although the demand for fish has two distinct components, that for direct human consumption and the derived demand which operates through the demand for fish meal, only the former has been projected since, in fact for reasons discussed below usage of fish for the production of meal seems likely to remain relatively unchanged.

18. Fish meal is used, in combination with other ingredients such as soya bean meal and skimmed milk powder, in the preparation of protein feeds for animals in particular pigs and poultry. In the short run demand for protein feeds is expected to rise by a little over 3 percent annually and something of this order of magnitude can be expected to the end of the century. However, most stocks of fish providing the basis for fish meal industries are fully or over exploited and fish meal production has for a decade fluctuated at a level some 15 percent below its peak in 1970. Thus the resource situation seems likely to prevent substantial increases in demand for protein feeds in general being translated into greater production of fish meal.

19. At the same time, the fishmeal market seems to have suffered permanent damage because of the shortages and very high prices which followed the collapse of the Peruvian anchoveta. Compounders are now less keen to include fishmeal in their feeds, although they would if price advantages became marked. This seems unlikely to occur because higher prices will be necessary to bring new sources of supply under production. Higher prices however encourage the greater use of substitute ingredients in compound feeds. Thus for reasons concerned with both the resource and the market the usage of fish for meal seems unlikely to be higher by the end of the century than at present.

20. Demand for fish for direct human consumption is less supply constrained - at least in the period to 1990 - and some increase in consumption is likely. On the basis of the present projections (Scenario B - the more pessimistic) demand by 1990 will be at least 23 million tons higher than in 1975 and by the end of the century the 44 million ton increase will have taken total demand to a point very close to the potential supply of conventional fishery resources. Of the total increase in demand 33.0 million tons (or 76 percent) will occur in developing countries - particularly the Far East, both populous and fish conscious, and where demand is projected to grow by 16 million tons by the end of the century.

21. The relatively high growth rates for income even on Scenario B (over 5 per cent per annum for developing countries) give significant increases in per caput consumption, 3.7 kg in the developing countries as a whole, rather more than average in the Far East and Asian centrally planned countries and less in other developing regions. Population growth accounts for about a third of the total increase in demand.

22. In the developed countries the absolute increase in demand is only one third of that in the developing World but because of the lower rates of population growth projected increases in per caput demand are somewhat larger. Increases of 5 kg or more, for example, are projected for the USSR and the countries of eastern Europe, but here projections relying heavily on coefficients derived from past experience may be a particularly poor guide.

Table 4(a): Estimated Demand for Fish 1980, 1990, 2000 (in live weight equivalent) - Scenario A

Region	Total million tons				Feed million tons	Food million tons				Food Kg/Caput			
	Consumption	Projected Demand 1/			Consumption	Consumption	Projected Demand			Consumption	Projected Demand		
	1974-76	1980	1990	2000	1974-76	1974-76	1980	1990	2000	1974-76	1980	1990	2000
WORLD	70.0	76.9	96.6	125.4	20.5	49.5	56.4	76.1	104.9	12.3	12.8	14.5	17.0
Developing	26.5	30.9	45.9	70.4	3.7	22.8	27.2	42.2	66.7	7.9	8.4	10.6	13.8
Latin America	3.9	4.3	5.8	8.1	1.5	2.4	2.8	4.3	6.6	7.3	7.6	9.1	10.8
Africa	3.0	3.5	5.7	9.3	0.1	2.9	3.4	5.6	9.2	8.8	9.0	10.9	13.6
Near East	0.8	0.9	1.5	2.3	0.2	0.6	0.7	1.3	2.1	3.0	3.4	4.4	5.8
Far East	10.7	13.2	20.2	29.7	1.3	9.4	11.9	18.9	28.4	8.6	9.6	12.1	14.9
Asian Central.Pl.C.	8.1	8.9	12.5	20.8	0.6	7.5	8.3	11.9	20.2	7.9	8.1	10.3	15.7
Other Developing	0.1	0.1	0.2	0.2	0.0	0.1	0.1	0.2	0.2	16.7	17.9	21.6	24.1
Developed	43.5	46.0	50.7	55.0	16.8	26.7	29.2	33.9	38.2	23.8	25.1	27.1	28.8
North America	5.6	5.9	6.6	7.2	2.0	3.6	3.9	4.6	5.2	15.3	15.9	16.9	18.1
Western Europe	14.0	14.4	15.3	16.1	7.3	6.7	7.1	8.0	8.8	18.4	19.3	20.9	22.3
EEC	9.1	9.3	9.7	10.1	5.0	4.1	4.3	4.7	5.1	15.9	16.6	17.8	18.8
Other W. Europe	4.9	5.1	5.6	6.0	2.3	2.6	2.8	3.3	3.7	24.7	25.6	28.0	29.9
E.Europe & USSR	12.6	13.6	15.5	17.2	3.8	8.8	9.8	11.7	13.4	24.2	25.8	28.4	30.7
E. Europe	3.6	3.9	4.1	4.4	2.2	1.4	1.7	1.9	2.2	13.3	14.7	16.3	17.3
Oceania	0.4	0.4	0.4	0.5	0.1	0.3	0.3	0.3	0.4	15.0	15.3	16.2	17.1
Other Developed	10.9	11.7	12.9	14.0	3.6	7.3	8.1	9.3	10.4	52.1	54.3	56.3	56.8

1/ Including demand for meal at 1974/76 level.

Table 4(b): Estimated Demand for Fish 1980, 1990, 2000 (in live weight equivalent) - Scenario B

Region	Total million tons				Feed million tons	Food million tons				Food Kg/Caput			
	Consumption	Projected Demand 1/			Consumption	Consumption	Projected Demand			Consumption	Projected Demand		
	1974-76	1980	1990	2000	1974-76	1974-76	1980	1990	2000	1974-76	1980	1990	2000
WORLD	70.0	76.9	92.6	113.5	20.5	49.5	56.4	72.1	93.0	12.3	12.8	13.7	15.1
Developing	26.5	30.9	42.5	59.6	3.7	22.8	27.2	38.8	55.9	7.9	8.4	9.7	11.6
Latin America	3.9	4.3	5.6	7.4	1.5	2.4	2.8	4.1	5.9	7.3	7.6	8.6	9.8
Africa	3.0	3.5	5.2	7.6	0.1	2.9	3.4	5.1	7.5	8.8	9.0	9.9	11.0
Near East	0.8	0.9	1.3	1.9	0.2	0.6	0.7	1.1	1.7	3.0	3.4	4.0	4.8
Far East	10.7	13.2	19.1	26.2	1.3	9.4	11.9	17.8	24.9	8.6	9.6	11.4	13.1
Asian Central.Pl.C.	8.1	8.9	11.1	16.3	0.6	7.5	8.3	10.5	15.7	7.9	8.1	9.0	12.2
Other Developing	0.1	0.1	0.2	0.2	0.0	0.1	0.1	0.2	0.2	16.7	17.9	20.6	22.9
Developed	43.5	46.0	50.1	53.9	16.8	26.7	29.2	33.3	37.1	23.8	25.1	26.7	28.0
North America	5.6	5.9	6.5	7.1	2.0	3.6	3.9	4.5	5.1	15.3	15.9	16.7	17.6
Western Europe	14.0	14.4	15.1	15.8	7.3	6.7	7.1	7.8	8.5	18.4	19.3	20.6	21.7
EEC	9.1	9.3	9.6	10.0	5.0	4.1	4.3	4.6	5.0	15.9	16.6	17.6	18.4
Other W. Europe	4.9	5.1	5.5	5.9	2.3	2.6	2.8	3.2	3.6	24.7	25.6	27.4	28.9
E.Europe & USSR	12.6	13.6	15.2	16.6	3.8	8.8	9.8	11.4	12.8	24.2	25.8	27.7	29.3
E. Europe	3.6	3.9	4.1	4.4	2.2	1.4	1.7	1.9	2.2	13.3	14.7	16.3	17.3
Oceania	0.4	0.4	0.4	0.5	0.1	0.3	0.3	0.3	0.3	15.0	15.3	15.9	16.6
Other Developed	10.9	11.7	12.8	13.8	3.6	7.3	8.1	9.2	10.2	52.1	54.2	55.8	56.1

1/ Including demand for meal at 1974/76 level.

23. In examining the situation emerging from the projections only Scenario B has been considered in view of the fact that even with the relatively pessimistic assumptions of this Scenario demand will clearly be pressing hard on the available resources before the end of the century. More rapid growth in income envisaged under Scenario A will merely bring nearer the time when the World's conventional fish resources are fully utilized.

24. Analysis of the problem at this high level of aggregation is, however, rather theoretical since there is not a demand for fish but for certain types of fish and fish products. Many of these are already fully exploited, e.g. salmon, many demersal fishes such as cods, flounders, etc. and some crustaceans and with the consequent rise in price demand has been transferred to other species. However, given the great variety of fish products there is not complete transferability of demand from one species to another and it may well be that some stocks in some areas will remain under exploited while most are fully harvested. Apart from the heterogeneity of species some stocks in some areas may remain underexploited while others are fully fished, e.g. herring and herring like fish in the North and South Atlantic.

25. On a regional basis adjustment will take place over time through trade. The creation of EEZs is likely to affect the pattern of trade as much as it affects the pattern of production. In particular, the gradual closing of the option of distant water fishing as a means of supplementing domestically caught fish is likely to oblige a number of major fish consuming countries to purchase fish from abroad through normal commercial channels. Offsetting this trade-creating effect, however, is the possibility of import replacement where importing countries acquire jurisdiction over types of fish from which products similar to the imported ones can be made. In addition, some decline in exports can be expected from those countries with distant water fleets who were also exporters but who will either not now have the fish to export or who will divert exports to the domestic market.

26. The net effect of the EEZs, however, is likely to be trade creation, and world trade in fishery products is likely to grow more rapidly than production generally constrained by resource limitation. The greatest potential demand for additional imports will be in the developed countries, e.g. Japan and the EEC, and could be met to a significant extent by exports from other developed countries, e.g. Canada and Norway, but to an increasing degree supplies are likely to come from developing countries, e.g. Argentina and other South American countries. By the end of the century, however, some developing countries will themselves have substantial import requirements not only to meet increased demand but, in some cases, to maintain existing levels of consumption. Among these countries are some with sizeable populations, e.g. India, Bangladesh and Egypt, and some likely to experience serious difficulties in meeting demand for other forms of animal protein, e.g. Ghana, Ivory Coast and again India.

27. Only part of the growing supply/demand imbalance at the world level will be resolved by trade, however, and some rise in the relative price of certain types of fish in certain areas seems inevitable. The most rapid rises can be expected in the price of those commodities whose supply, due to resource constraints, is most inelastic. This group includes most crustaceans, salmon and prime demersal fish but it will, by the nineties, include also many fish consumed predominantly in developing countries, e.g. freshwater fish in Africa. While in theory a rise in price offers opportunities for trade, in practice the possibilities are likely to be at least partly limited by transport and other costs and the heterogenous nature of fishery products which imposes some limits on substitutability.

28. Since fisheries operate on a fixed resource base, rising demand would be expected to produce a rise in the price of fish relative to commodities whose

supply is more elastic and evidence from many parts of the world confirms this prediction. In Japan for example, which is the World's largest market for fish, prices have on average been rising at 6.5 percent per year more than that of other commodities for some two decades. Similarly, in the United Kingdom, a recent study reveals that throughout the seventies fish prices have been rising more rapidly than meat and other competing protein foods. There is evidence also from developing countries and studies reveal roughly similar trends in Ghana and the Philippines. This trend seems likely to continue in spite of periods such as the present when increases in the unit cost of inputs makes fishing temporarily unprofitable. The long run trend is clearly for increasing relative prices which will not only reduce actual consumption below the projected demand but will also make more difficult the problems of management.

E. ACTION REQUIRED FOR FURTHER DEVELOPMENT AND RATIONAL MANAGEMENT

29. The preceding paragraphs have indicated in broad outline the most likely trends in world fisheries to the end of the century. Insofar as it is possible to generalize from these, it is clear that the main issues of concern to many national policy makers will arise from the growing shortage of fish. Appropriate actions to meet this challenge can be broadly classified as follows:

(i) Efforts to increase production either of those conventional species remaining unexploited or of unconventional species or through aquaculture;

(ii) Improved utilization of fish now caught, including the diversion to direct human consumption of those fish now used for fish meal, and the reduction of post harvest losses;

(iii) Attention to the problems of management to ensure that already exploited resources continue to provide the desired economic and social benefits.

Efforts to increase production

30. The possibilities and problems of increasing the catch of conventional species have already been discussed in paragraphs 6-13. Where there is a need for increased fishing effort this will in some cases be brought about by normal commercial pressures. In other circumstances some form of outside assistance will be required either from national governments, e.g. incentive schemes, or international agencies, e.g. grants, loans or technical assistance. From multilateral sources, in terms of costs at least, the most important projects to be financed will be those concerned with infrastructural investment, e.g. marine works including new and improved harbours and port facilities. Investment in this field, which has traditionally been the most important area for regional and international bank financing, could be further boosted by the rising cost of fuel and the desirability of establishing fishing bases near to the fishing grounds.

31. Improved facilities on shore including especially communications will help to reduce wastage and improve marketing prospects. These considerations apply a fortiori to small-scale traditional fisheries where often limited marketing opportunities, waste and poor quality result in low returns and give little incentive to fishermen to increase their catches. Without such improvements to the shore-based infrastructure, attempts to improve vessels (i.e. through motorization schemes) have often failed since, without better marketing opportunities and consequently higher prices, motorization merely adds more to costs than to revenues. As indicated, requirements to improve the situation are much the same as for more industrialized fisheries, i.e. facilities to handle and dispose of the catch and also facilities for the repair and maintenance of small fishing craft.

32. The pattern of investment in new vessels is complex but some additional vessels would seem to be required in spite of the excess capacity already existing in the world as a whole. Additional vessels will be required to exploit opportunities in some recently established EEZs, i.e. those having unexploited potential or stocks previously exploited by foreign fleets. For technical and economic reasons it will probable not be possible to re-deploy as fishing vessels much of the redundant capacity of the former distant water fleets. Even vessels which are not redundant, however, may need to be replaced with vessels of different design which consume less fuel. In Japan, for example, the skipjack fleet is being replaced by vessels which can achieve up to 30 percent savings on fuel through re-designed hulls and improved methods of propulsion, etc.

33. Investment in vessels has largely been the responsibility of the private sector (except of course in completely socialized economies) and this will by and large probably remain the case. Apart from marketing and infrastructural deficiences, the main brake on the growth and development of fisheries is usually management and entrepreneurial ability and attempts to force the pace of development where these skills have been lacking have generally met with limited success. Where there are opportunities for investment the ease with which excess capacity can develop has so frequently been demonstrated (and not only in high income countries) that any programme of vessel construction requires built-in monitoring to assess also the effect on the stocks and, because of the lag between the decision to construct and the operation of vessels, should be approached with caution.

34. Among the unconventional species, greatest progress has been made with krill and commercial pressures have already resulted in the development of technically efficient methods for its harvesting and processing. Products developed so far, however, are relatively sophisticated and costly and the possibilities of a mass market for krill products is still some distance away. One of the problems is that in order to provide a product which is commercially competitive with other forms of animal protein the scale of any operation would have to be very large - perhaps producing krill in greater quantities than most markets could absorb. Attempts to produce and market a subsidised product would, of course, need to be evaluated against other forms of protein production.

35. Somewhat further away is the utilisation of meso pelagic species - the small boney fish found widely distributed throughout the world's oceans. Research and development work on this group of animals is only now beginning and while it seems that there are few technical problems involved in their harvesting, the difficulty, as ever, lies in the development and marketing of suitable low cost products. The most promising strategy for the commercial exploitation of these fish would seem, therefore, to lie initially in the production of fish meal and in this respect the major requirement is for the establishment and operation of a pilot project. In the long run, however, there are good prospects that these fish can contribute in significant measure to human nutrition directly, particularly as they are found in proximity to many countries having nutritional problems.

36. More immediate prospects of increases in production are offered by aquaculture which as well as increasing food supplies can make a significant contribution to rural development through raising the income of small farmers. Apart from developing specific aquaculture schemes these objectives can be achieved through introducing fish as an additional crop with other animals, e.g. pigs or ducks, or by introducing the rearing of these other animals to fish farmers - in either case recycling waste. These and other techniques for raising the productivity of aquaculture are well known; the problem is to achieve their more widespread adoption.

37. The conditions for achieving an increase in production from aquaculture are much the same as for agriculture. In almost all countries with a favourable national environment the initial requirement is for organization, that is for some agency (government, parastatal, private) to convince farmers of the benefits of aquaculture, to organize the supply of inputs including, in particular, fish seed, and assisting with marketing. Once the commercial feasibility of any technology or new development has been demonstrated the main requirement is for an extension service which in most countries implies a substantial training programme.

38. Training at all levels from senior research workers downwards is, in fact, likely to be one of the major long run constraints to the expansion of aquaculture in most areas, and the provision of the necessary facilities will clearly require outside assistance. An equally important object of expenditure is the provision of credit. The primary source of financing for small-scale rural aquaculture in most developing countries is public credit schemes, and aid to aquaculture from outside sources can best be channelled through these institutions which are gradually acquiring expertise in this field. Clearly, however, successful development requires that the availability of credit should not outrun the capacity of the extension services to supervise its expenditure.

Improved Utilization

39. Apart from attempts to increase the total catch, an important matter requiring attention is the improved utilization of fish already being exploited. It has been estimated that as much as 20 percent of all fish taken from the sea and fresh waters never reaches the consumer; there are thus considerable possibilities for increasing the supply of fish through improved utilization. There are two main situations where waste can be prevented or reduced, namely in the utilization of by-catches of fish caught by shrimp trawlers and by reducing losses of cured fish in tropical countries. Part of the remedy in both these cases lies in providing the necessary economic incentives, but an important element in any programme to avoid waste is improvement in the on-shore handling and storage facilities to which reference has already been made.

40. Attention was drawn in paragraph 22 above to the need for research and development to permit the utilization for direct human consumption of at least some shoaling pelagic fish now used for reduction to meal and oil as well as of those shoaling pelagic stocks still relatively under-exploited. Some progress has been made in this through the development of type B fish protein concentrate and, although this has been manufactured and marketed commercially, the quantities involved have been small. The problem as ever remains one of finding an acceptable product at a sufficiently low cost - which for many markets rules out canning. Present efforts to increase consumption of these fish are directed to improving the quality of traditional products such as dried and salted fish as well as longer range projects concerned with minced fish.

41. Detailed project by project assessments of investment requirements are not available but some indication of such requirements can be given on the basis of the incremental capital/output ratio. Assuming this to be 4:1 (fishing is generally a more capital intensive activity than agriculture), net investment requirements in the primary sector would be of the order of $20,000 million with an average price of fish of $400 per ton, bearing in mind that as much as half of the projected increase in the world catch is due to management, i.e. recovery of overfished stocks, which will take up underutilized capacity rather than require new vessels. Total net investment requirements are considerably above this figure, however, since as already noted emphasis needs to be given to improved handling and processing and thus a figure of $35,000 million would be nearer the true needs.

This figure makes no allowance for investment in the harvesting of krill or meso pelagic species to this extent and in whatever form these will be exploited and it must thus be regarded as conservative.

Management

42. Many of the problems associated with production are likely to be solved only in the medium and long term. More immediate are the problems of ensuring the maintenance of high and sustained yields from already exploited stocks. The management issue is relatively urgent not only because of the new legal regime of the seas - a change which has considerable implications for the mechanisms by which international fisheries are regulated - but also because of the increasing number of stocks requiring management action to restore yields and reduce excessive costs.

43. Overfishing first became an issue in the early years of the present century in connection with the demersal fisheries of the North Sea. In spite of early recognition of the problem, most attempts at management have not been attended by conspicuous success and the effects of unrestricted expansion - ranging from declining profitability to complete collapse of a stock - have been repeated again and again. These effects have been observed in fisheries in a wide range of eco-systems and in the context of both single and multi-species fisheries. Present changes in the Law of the Sea reflect, in part, dissatisfaction with previous arrangements.

44. In those areas where serious economic distress in the fisheries made some action necessary, these arrangements frequently took the form of International Commissions, e.g. ICNAF (the International Commission for the Northwest Atlantic Fisheries). In general, this system met with only limited success but certainly left the stocks in better condition than they would have been without such management. The Commissions had a positive impact on the development of methods for resource evaluation and on the understanding of the various problems of fisheries management. In fact, these bodies were very suitable for the technical aspects of the problem but not for the political aspects related to authority and decision making. Arrangements under an EEZ regime offer the prospect of improvement in the latter by establishing authority and responsibility for the resources and their exploitation.

45. The establishment of sovereign rights in the fisheries in a coastal band of 200 nautical miles will, however, not of itself ensure that fish stocks - even those occurring exclusively in one national zone - will be managed satisfactorily in accordance with national economic and social priorities. Effective management requires adequate institutional arrangements including appropriate laws, adequate research capability (or at least access to the required information), and the necessary means of surveillance and enforcement. Many developing countries lack at least one of the major tasks of international assistance for the foreseeable future.

46. Additional problems arise in the case of those stocks of fish which are present, through migratory and life-cycle patterns, in more than one exclusive economic zone. In such cases of shared stocks, successful management depends upon agreement between the countries concerned in determining the desirable level of total catches from that stock, followed by agreement on how this "total allowable catch" should be allocated, i.e. shared between the countries concerned. Once such agreement has been reached on these issues, enforcement is now facilitated as, under the new legal regime, jurisdiction within each EEZ rests solely with the individual coastal states.

47. While a significant proportion of the world's fishery resources is likely to come under bilateral arrangements, regional fishery bodies offer excellent fora for the discussion of scientific, administrative and political problems and for the negotiation of agreements between neighbouring countries sharing stocks. These bodies can provide for collaboration in research into the principles and methods that will enable member countries to assess and monitor fish stocks in their waters. Furthermore, they can facilitate economic and technical cooperation in fishery development including, if the member countries agree, the determination of total allowable catches and their allocation.

48. A major task of regional fishery bodies is to link field projects within their areas to management and development strategies determined by their members. Most FAO regional fishery bodies already have major regional or inter-regional development programmes associated with them. To meet the new needs of their member countries, smaller management units will probably be required within both the fishery bodies and associated field programmes.

F. MAIN INTERNATIONAL POLICY ISSUES

49. Apart from appropriate action to increase production and reduce waste including the waste of over exploitation, a number of major issues of policy will require attention in the period to the end of the century. Among them will be those concerned with the continuing process of adjustment to the new regime of the seas, in particular demarcation disputes which will involve not only questions of where the lines are drawn between adjacent EEZs, but also on the relative shares of the catch of common stocks. Some of these issues have been touched on in previous paragraphs but it should be noted that there are as yet no commonly agreed principles as to how the potential yield from any stock should be divided, although there is a growing presumption that account should be taken of the distribution of the stock throughout its life history and not just on the contingent distribution of catches over a few years. The absence of hard facts on this makes it almost certain that agreement on these issues will be difficult to reach.

50. A specific instance of this general problem concerns the management of oceanic species and in particular tuna. These can be caught not only in different EEZs but outside 200 miles altogether. The management of tuna has been discussed at various sessions of the Law of the Sea Conference and it has been recognized that these species present problems by placing them in a special category of "highly migratory species". Apart from calling for appropriate consultation and cooperation the present draft text does not give much practical guidance but it is clear that ideally some form of supranational authority is required. A device similar to that being adopted in the North West Atlantic might be an appropriate first step, i.e. the establishment of a body having responsibility for scientific matters throughout the whole area of migration of the species but with powers of regulation only outside 200 miles. This would still leave unresolved the problems of reconciling measures adopted within different EEZs and within and without 200 miles.

51. Energy problems are considered in general in chapter 9 but some specific considerations concerning fisheries are appropriate here. Increases in the cost of fuel are just one of a number of increased costs which the fishing industry - along with other food producing industries has had to bear in recent years. In principle, increases in the cost of any input to fishing is no different from a tax, a measure which has been frequently recommended as a means of reducing fishing effort where this is excessive, i.e. in those situations where vessels could be removed from the fishery without reducing the total catch or at least reducing it much less than proportionately to the costs. Thus there is a positive side to cost increases in fisheries, but the advantage of a tax is that the revenue raised can be used to

rehabilitate displaced fishermen while there is no such freedom with cost increases resulting from more expensive fuel, vessels, gear and other inputs.

52. Where fishing effort is not already excessive, cost increases can have more negative effects in inhibiting full exploitation of resources, particularly of less dense stocks, and stocks of less commercially valuable species, e.g. as is presently occurring in some tropical areas such as the Gulf of Guinea. More recently, however, even where these conditions are not found, the sharp increases in the price of fuel have made many fisheries at least temporarily unprofitable and have hindered motorization programmes. Pessimism concerning fuel prices is, however, somewhat inconsistent with the analysis of the preceding section which has indicated that many problems in fisheries over the next two decades will stem from a continuing increase in the relative price of fish. It may well be that recent past experience of costs outstripping prices is not a pointer to the future and over the long run price increases will maintain the general economic health of fisheries. Also on the side of costs there are yet possibilities for savings through changes in fishing methods and re-design of vessels and gear.

53. Finally, mention should be made of the issues surrounding conflict in the use of coastal zone resources. This is already a serious problem in the waters off some developed countries. Pollution of coastal zones does not as yet pose a serious threat to free swimming stocks but it is having an adverse effect on coastal aquaculture, particularly of molluscs. Land reclamation schemes and the creation of shore line structures also have an adverse effect on nursery grounds for fish. Perhaps the most well publicized use of coastal zones is now the production of oil but other activities pose an equal threat including particularly mining. However immediately attractive other uses of the oceans may appear, it should be remembered that fish is a self-renewing resource which, if well managed, will forever yield a continuous flow of income.